

*Babich* is directed to depositing a hydrogenated amorphous carbon film via sputter deposition techniques and *Lin* teaches the use of a silicon containing photoresist material. *Babich* and *Lin*, alone or in combination, do not teach or suggest depositing a silicon containing photoresist layer on top of an amorphous carbon layer, and then forming an *in-situ* resist layer hard mask in an outer portion of the photoresist layer during a process of etching through the amorphous carbon layer, as recited in Applicants' independent claims 1 and 36. Therefore, Applicants respectfully request reconsideration of the rejection of claims 1 – 7 and 36 – 42.

Claims 10 – 14, 16 – 26 and 30 – 35 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Babich* in view of *Lin* and *Mitani* (U.S. Patent No. 6,191,463). The Examiner takes the position that *Mitani* teaches deposition of silicon oxide via a CVD process, and therefore, the Examiner concludes that the combination of references teaches or discloses each and every limitation recited in claims 10 – 14, 16 – 26 and 30 – 35. Applicants respectfully traverse the rejection.

Prior to addressing the substantive portion of the rejection, Applicants note that each of claims 10 – 14 and 16 depend from claim 1, which have been argued as allowable above. Therefore, Applicants submit that each of claims 10 – 14 and 16 are allowable as a result of being dependent upon an allowable base claim. As such, reconsideration and withdrawal of the rejection of claims 10 – 14 and 16 is respectfully requested.

Applicants further submit that *Mitani* teaches a method for improving an insulating film deposited on a semiconductor device. The improved insulating layer is generally disclosed as a silicon oxide or silicon nitride film deposited via a chemical vapor deposition process. *Babich*, *Lin*, and *Mitani* alone or in combination do not teach or suggest forming an *in-situ* hardmask layer in the outer surface of a photoresist layer during an etching process, as recited in independent claims 1 and 17, the independent claims from which each of claims 10 – 14, 16 – 26, and 30 – 35 depend. Rather, *Mitani* is directed to a separate deposition process configured to deposit a silicon oxide layer, while the claimed invention forms the hardmask layer *in-situ* during an etching process and not through a deposition process. Therefore, withdrawal of the rejection is respectfully requested.

Claims 8, 9, 43 and 44 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Babich* in view of *Lin* and *Yang* (U.S. Patent 6,165,695). The Examiner takes the position that *Babich* and *Lin* fail to teach the use of a layer of photoresist having a thickness of less than 500 angstroms. However, the Examiner cites to *Yang* as disclosing a method of manufacturing a semiconductor device, wherein the method uses an ultra-thin layer of photoresist having a thickness of between 50 and 2000 angstroms. Applicants traverse the rejection and respectfully submit that the cited combination of references fails to teach or suggest each of the limitations recited in claims 8, 9, 43, and 44.

Prior to addressing the substantive portion of the rejection, Applicants note that each of claims 8, 9, 43 and 44 depend from either claim 1 or claim 36, both of which have been argued as allowable above. Therefore, Applicants submit that each of claims 8, 9, 43 and 44 are allowable as a result of being dependent upon an allowable base claim. As such, reconsideration and withdrawal of the rejection of claims 8, 9, 43 and 44 is respectfully requested.

Applicants further submit that claims 8, 9, 43 and 44 recite subject matter that is not taught, or suggested by the cited combination of references. Specifically, *Babich* and *Lin* are discussed above, and *Yang* teaches a thin resist layer with an amorphous silicon hard mask to be used for an etch application. The resist layer is disclosed as having a thickness within the range of 50 angstroms to 2000 angstroms (Column 3, lines 25 – 26). However, the combination of references do not teach or suggest the use of a silicon containing photoresist material on top of an amorphous carbon film, wherein the silicon containing photoresist material forms an *in-situ* hard mask in an outer portion thereof when exposed to an etchant configured to etch into the amorphous carbon layer, as recited in independent claims 1, 17, and 36. Therefore, withdrawal of the rejection of claims 8, 9, 43, and 44 over the cited art is respectfully requested.

Claims 27 and 28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Babich* in view of *Lin*, *Mitani* and further in view of *Yang*. In similar fashion to previously discussed claims, Applicants submit that claims 27 and 28 depend from claims already argued as allowable, and therefore, Applicants submit that claims 27 and 28 are also allowable. Further, Applicants further submit that claims 27 and 28 are

allowable, as combination of the references with *Mitani* fails to further the teaching of *Babich* and *Lin* to the level necessary to support an obviousness rejection. In particular, Applicants submit that combination of *Babich*, *Lin* and *Mitani* fails to teach or suggest the formation of an *in-situ* hardmask layer in an outer portion of the resist layer, as recited in independent claim 17, the claim from which claims 27 and 28 depend. Therefore, withdrawal of the rejection of claims 27 and 28 is respectfully requested.

Claim 15 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Babich* in view of *Lin* in further view of *Sobczak* (U.S. Patent No. 4,576,834). Applicants traverse the rejection and respectfully submit that claim 15 recites subject matter that is neither disclosed, taught, nor suggested by the cited combination of references. In particular, claim 15 depends from claim 1, which recites forming the *in-situ* hardmask layer in the outer portion of the resist layer discussed above. Therefore, since claim 1 has been argued as allowable above, Applicants submit that claim 15 is also allowable as a result of being dependent upon an allowable base claim. Further, *Sobczak* also fails to teach the *in-situ* hardmask layer formation, and therefore, Applicants submit that the cited combination of references fails to teach or suggest each and every limitation within claim 15. As such, reconsideration of the rejection of claim 15 is respectfully requested.

Claim 29 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Babich* in view of *Lin*, *Mitani*, and *Sobczak*. Applicants traverse the rejection and respectfully submit the claim 29 recites subject matter that is neither taught nor suggested by the cited combination of references. Claim 29 depends from claim 17, which recites a method for patterning a material layer in a multilayer stack, wherein the method includes depositing a silicon containing photoresist layer over an amorphous carbon layer. The photoresist layer is patterned, and then the amorphous carbon is etched away while an *in-situ* hard mask layer is simultaneously formed over the top of the photoresist layer. The cited combination of references, either alone or in combination, fails to teach, show, or suggest forming the *in-situ* hardmask in the resist layer during the etching step, as discussed above. Therefore, Applicants submit that the cited references fail to teach, show, or suggest each and every limitation recited in

claim 29, and as such, reconsideration of the rejection of claim 29 is respectfully requested.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed aspects of the invention. Having addressed all issues set out in the office action, applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted, ✓



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## APPENDIX

1. (Amended) A method for forming a patterned amorphous carbon layer in a multilayer stack, comprising:

depositing an amorphous carbon layer on a substrate;

depositing a silicon containing photoresist layer on top of the amorphous carbon layer;

developing a pattern transferred into the resist layer with a photolithographic process;

[etching through the amorphous carbon layer in at least one region defined by the pattern in the resist layer;] and

forming an in situ resist layer hard mask in an outer portion of the photoresist layer while etching through the amorphous carbon layer in at least one region defined by the pattern in the resist layer.

17. (Amended) A method for patterning a material layer in a multilayer stack, comprising:

depositing an amorphous carbon layer on the material layer;

depositing a photoresist layer on top of the amorphous carbon layer;

developing a resist pattern transferred into the photoresist layer;

[etching through the amorphous carbon layer in a patterned region defined by the resist pattern;]

forming an in situ resist layer hard mask in an outer portion of the photoresist layer [during the etching process for the amorphous carbon layer] while etching through the amorphous carbon layer in a patterned region defined by the resist pattern; and

etching through the material layer under the amorphous carbon layer using the patterned region etched into the amorphous carbon layer and the resist pattern.

36. (Amended) A method for forming a hardmask in a resist layer, comprising:

depositing a silicon containing photo resist layer over a material layer;

developing a pattern in the silicon containing photo resist layer;

[etching the material layer with an oxygen based etchant to transfer the pattern into the material layer;] and

forming a hardmask layer in the silicon containing photo resist layer [during the etching process] etching the material layer with an oxygen based etchant to transfer the pattern into the material layer.